Mooreville Fire and Fuels

Location of Mooreville and Fire Bioregion

The Mooreville project is located within a lower montane forest of the Sierra Nevada Bioregion, primarily on the west side of the range above the foothill zone. The Sierra Nevada is a large landscape that tilts west-southwest that extends from the southern Cascade Mountains in the north to the Tehachapi Mountains and Mojave Desert to the south (Wagtendonk, Jan W., et al. 2018). Within this bioregion the Mooreville project lies on the west slope of the Feather River RD of the Plumas NF, towards the north end of the region near the Feather and Yuba River drainages.

Pre Euro American Fire Regime

It is common language between land managers that the fire regimes of today’s vegetation has been altered from the pre Euro-American settlement regimes of the past. Records of historic forest data and fire occurrences can give an insight to historic forest stand structures and disturbances, but this data is sparse and doesn’t contain very thorough detail until the mid-20th century. Fire history can be found in Geospatial Information System (GIS) of Forest Service records, but these records usually contain fires that met criteria of a specific size and acreage e.g., fires over 100 acres in size. While being unable to show the history of smaller more frequent fires. Today’s research contain reconstructions of historic data, based on landscapes that have had frequent fires and little to no human disturbance. With these reconstructions managers can get an indication of how the Natural Range of Variation (NRV) was expressed. The reconstructed data can then be compared to the NRV of current forest stands that currently have longer fire return intervals, efficient fire suppression policies and human disturbance of logging and forest urbanization.

Van de Water and Safford (2011) provide a summary of pre Euro-American settlement fire regime groups (PRFs) of pre-settlement fire frequency estimates of California ecosystems dominated by woody plants. Through their reconstructions, the vegetation and forests of Mooreville Project best resembles the Mediterranean California mesic mixed conifer forest and woodland, resembling a PFR of dry mixed conifer forest. The PFR of this woody species characteristic has a mean fire return interval of 11 years and a max mean of 50 years. Based on the mean fire return interval the pre Euro-American settlement fire regime could be Fire Regime Condition Class (FRCC) 1, having a frequent fire return interval of 0-35 years with low to moderate severity fires.

Fires during this time period were naturally or indigenous ignited fires and could be generalized as being able to freely burn throughout the landscape, “cleaning up” the forest floor and new growth with low to moderate fire behavior effects without any modern suppression efforts. These historic large landscape fires could have “put themselves out” by burning into unburnable locations such as rocky ridge outcrops, water sources, seasonal ending weather systems and areas that had previously burnt within the NRV.

Fire History/Fire Regime 1900 to Present

Records of large fires, fires that were not suppressed during the first burning period of initial attack, are present between the years of 1919 and 2009, showing a total of 19 fires within the Mooreville project watershed analysis area. These fires ranged from 10 acres to over 5,000 acres in size. The largest being an unknown name and cause fire from the year 1931 and the Devil's Gap fire that burned in 1999. The Devils Gap fire was the convergence of two lightning fires; this fire burned with high intensity resulting in approximately 90 percent mortality of vegetation. Multiple smaller fires have occurred throughout the analysis area, smaller fires either ignited by lightning or human caused means that were contained and controlled during the first burning period of the initial attack phase. See Table 1 for a list of large fires in the analysis area. Visual representation is shown in Figure 1.

The Mooreville project fire history data was collected using ArcMap 10.5.1 (ESRI, 2018) which displays fires that have burnt within the FRCC1 criteria, 0-35 years, but in sporadic areas for minimal acreage. Due to fire exclusion, past harvesting practices, and changes in various other land practices, there is now a decrease in the incidence of historic low intensity fires, allowing for a build-up of surface and canopy fuels (Peterson et al. 2005). The wild fires ignited today are still burning within the 0-35 year criteria of FRCC1, however these fire are expected to burn with moderate to high severity.

Year	Cause	Acres
2009	Campfire	167
1927	Unknown	206
1921	Unknown	287
1929	Unknown	308
1921	Unknown	352
1921	Unknown	376
1946	Misc.	424
1920	Unknown	589
1929	Unknown	746
1926	Unknown	794
1919	Unknown	951
1921	Unknown	1,000
1987	Unknown	1,047
1999	Lightning	1,480
1931	Unknown	5,468

Table 1. Fires greater than 100 acres that occurred between 1900 and 2013 (USDA ARC GIS 10.3.1)

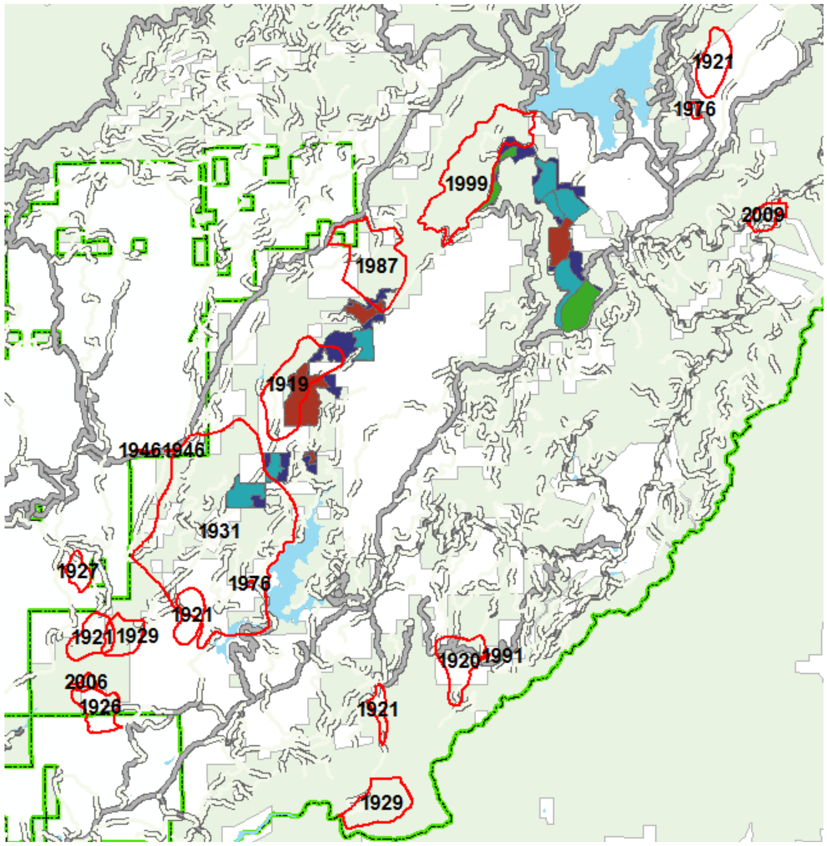

Figure 1. Fire History Mooreville

Current Conditions

Fire Behavior and Fuel Models

The modeling of potential fire behavior was done under 90th percentile weather conditions, (Table 2) which were obtained from the Pike County Remote Automated Weather Station (RAWS), south of the project area. Weather conditions at the station are recorded on a ridge top, reflecting ―hottest and driest weather conditions within an area with virtually no canopy cover. This weather data is calculated using Fire Family Plus (Main et al. 1990). BehavePlus Fire Modeling System (Andrews, 2018) software program was used to model and assess the effects of different treatments on fire behavior. The different vegetation configurations within the project area were assigned fire behavior prediction fuel models (Scott and Burgan, 2005) through LANDFIRE (2013). A general description of the fuel models used in this analysis is summarized in Table 3 below.

This information was processed and utilized in the BehavePlus model where fuel models were developed to determine existing and post-treatment surface and crown fuel conditions as well as determination of potential fire behavior and effects associated with the treatments. Fire behavior results displayed in this report were based on aspect, slope, strategic suppression location, and harvest and fuel treatment types.

Variable	90^{th} Percentile Wx Ops	97^{th} Percentile Wx Ops
Woody Fuel Moisture	70%	70%
Herbaceous Fuel Moisture	30%	30%
Wind Speed - MPH	10 MPH	12 MPH
Relative Humidity	17%	14%
Dry Bulb Temperature	91	94
1 – HR Fuel Moisture	2.72	2.35
10 – HR Fuel Moisture	3.27	2.83
100 – HR Fuel Moisture	4.86	4.86
1000 - HR Fuel Moisture	5.77	5.35

Table 2 - 90^{th} Percentile Fire Weather Mooreville Project

Mooreville's 3030 acre project consists of 3 major fuel model indicators. Grass Shrub model at 4 percent, various dead and down fuel levels in the Timber Litter model at 19 percent. The majority of the project area is represented by the Timber Understory fuel model at 74 percent of project acres, Table 4.

The specific fuel model express in the Timber Understory indicator is represented as TU5, where fire is primarily carried through the forest ground fuels and smaller trees. As a result of surface and canopy treatments proposed by the Mooreville project, the FRRD expects that the existing fuel models will be modified post treatment. Units which have commercial thinning performed are expected to be modified from an existing TU5 to a TL1. Hand cut pile units will be modified from a TU5 to a TL3 and units with mastication will modify from a TU5 to a SH1, Table 5.

As stated the Mooreville treatments were modeled using the 90^{th} percentile fire danger weather conditions and a variation degree of slope, (0-45%) and canopy base heights (1- 30 feet). These fire modeling inputs were verified through ocular field reconnaissance and GIS spatial slope layers. Given that 90^{th} percentile days only take place 10 percent during critical fire weather conditions, it is during these periods where high severity fires can take place.

The fire modeling shows that the TU5 fuel model in 90^{th} percentile weather conditions had fire behavior conditions that were not effective for initial attack resources. Initial attack resources are most effective when engaging a surface fire with flame lengths 4 feet and less (NWCG 2006). TU5 existing fire behavior conditions has a minimum flame length of 9.9 feet, fire type is expressed as torching and transition to crown fire is possible. With the proposed commercial thinning treatment fuel model TL1 has flame lengths less than 1 foot in height, the fire type is a surface fire and there is not a transition to crown fire conditions. Similar reductions in fire behavior and severity are also shown using hand cut pile and mastication post treatments. All fire effects are shown in Table 5.

Fuel Model		Description
Timber-Understory Fuel Type Models (TU)		The primary carrier of fire in the TU fuel models is forest litter in combination with herbaceous or shrub fuels. TU1 and TU3 contain live herbaceous load and are dynamic, meaning that their live herbaceous fuel load is allocated between live and dead as a function of live herbaceous moisture content. The effect of live herbaceous moisture content on spread rate and intensity is strong and depends on the relative amount of grass and shrub load in the fuel model.
Very High Load, Dry Climate Timber-Shrub		
	TU5	The primary carrier of fire in TU5 is heavy forest litter with a shrub or small tree understory. Spread rate is moderate; flame length moderate. Fine fuel load (t/ac) 7.0
Timber Litter Fuel Type Models (TL)		The primary carrier of fire in the TL fuel models is dead and down woody fuel. Live fuel, if present, has little effect on fire behavior.
	TL1	The primary carrier of fire in TL1 is compact forest litter. Light to moderate load, fuels 1 to 2 inches deep. May be used to represent a recently burned forest. Spread rate is very low; flame length very low. Fine fuel load (t/ac) 1.0
	TL3	The primary carrier of fire in TL3 is moderate load conifer litter, light load of coarse fuels. Spread rate is very low; flame length low. Fine fuel load (t/ac) 0.50
Shrub Fuel Type Models (SH)		The primary carrier of fire in the SH fuel models is live and dead shrub twigs and foliage in combination with dead and down shrub litter. A small amount of herbaceous fuel may be present, especially in SH1 and SH9, which are dynamic models (their live herbaceous fuel load shifts from live to dead as a function of live herbaceous moisture content). The effect of live

		herbaceous moisture content on spread rate and flame length can be strong in those dynamic SH models.
	SH1	The primary carrier of fire in SH1 is woody shrubs and shrub litter. Low shrub fuel load, fuelbed depth about 1 foot; some grass may be present. Spread rate is very low; flame length very low. Fine fuel load (t/ac) 1.7

Table 3 - Scott and Burgan Fire Behavior Fuel Models (2007)

Fuel Models	**Acres**	**Percentages**
Row Labels	**Sum of Acres**	**Sum of Percentages**
GR1	2.7	0.1%
GR2	17.4	0.6%
GS1	32.9	1.1%
GS2	101.2	3.3%
NB1	9.0	0.3%
NB9	8.4	0.3%
SH1	0.1	0.0%
SH2	8.3	0.3%
SH3	6.1	0.2%
SH5	5.2	0.2%
SH7	0.8	0.0%
TL2	0.3	0.0%
TL3	50.3	1.7%
TL4	4.0	0.1%
TL5	106.9	3.5%
TL6	403.1	13.3%
TL7	2.1	0.1%
TL8	7.4	0.2%
TL9	1.2	0.0%

TU5	2262.7	74.7%
Grand Total	**3030.2**	**100.0%**

Table 4 - Fuel Models Mooreville Project

Treatment Type	Fuel Model	Flame Length	Fire Type	Transition to Crown
Existing	TU5	9.9	Torching	Yes
Mechanical Thin	TL1	0.8	Surface	No
Existing	TU5	9.9	Torching	Yes
Hand Cut Pile Burn	TL3	1.4	Surface	No
Existing	TU5	9.9	Torching	Yes
Mastication	SH1	0.9	Surface	No

Table 5 - Pre and Post Treatment Effects, Behave (2018)

Summary

The Prehistoric Fire Regime (Van de Water and Safford 2011) give an indication that the Mooreville area has had a change in fire effects due to early settlers, the heavy amounts of logging and fire suppression over the last decades have altered the fire frequency and return interval, resulting in high severity fires that occur within the NRV. The adjusted fuel models of the prescribed treatments all show modifications to the existing flame lengths, fire types and transitions. The modifications are an improvement to the existing conditions to the Mooreville project, however land managers and fire managers have further work to perform within this project area. The reintroduction of fire and using fire as a maintenance tool on a multiple year implementation plan, would work towards a desired condition of what the PFR this project historically experienced. Otherwise without multiple fire entries this project will continue to burn in moderate to high intensities and severity. Possibly causing large stand replacing fires that could change the entire landscape from a mixed conifer forests to chaparral brush like stands.

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